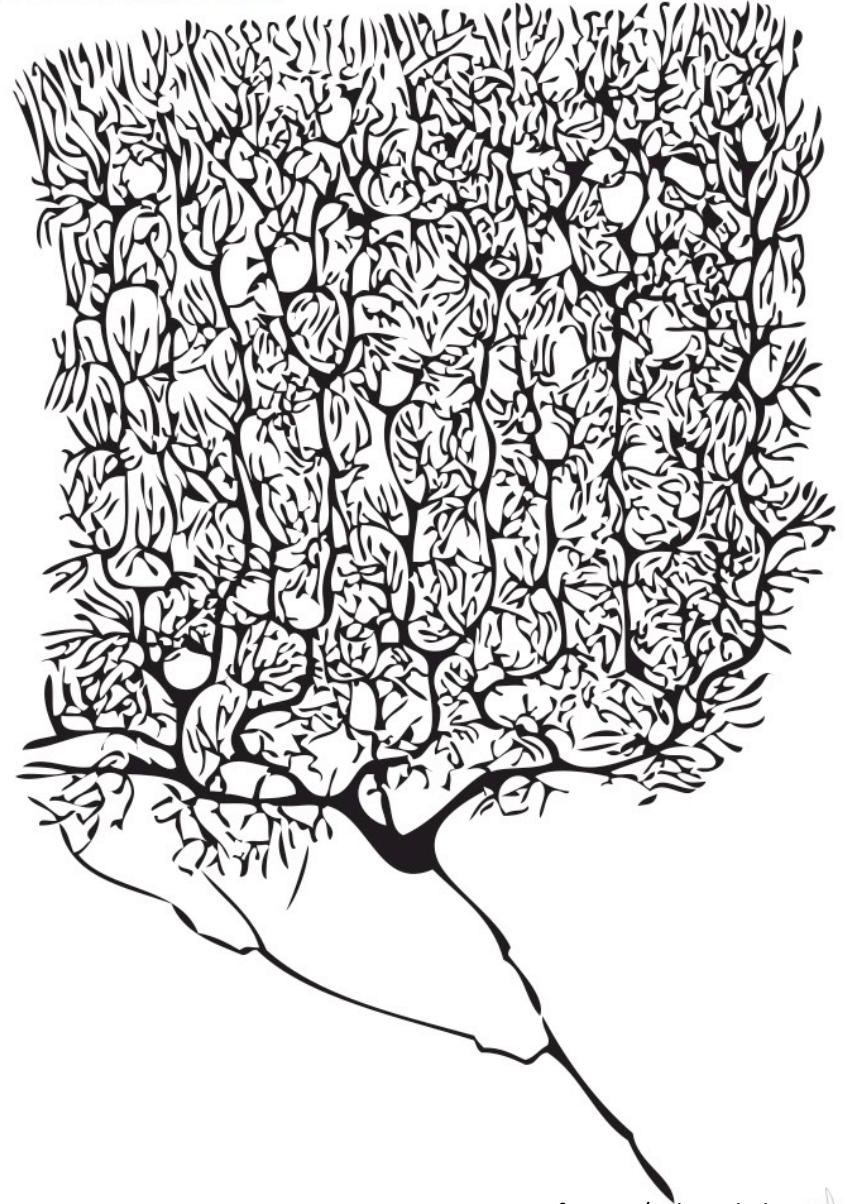


Cellular Electrodynamics

Santiago Ramón y Cajal (1852-1934)



Instructor:

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Website:

<http://www.yorku.ca/cberge/4080W2020.html>

York University
Winter 2020

BPHS 4080 Lecture 19

Reference/Acknowledgement:

- TF Weiss (Cellular Biophysics)

- D Freeman

Back to the question of spatial propagation...

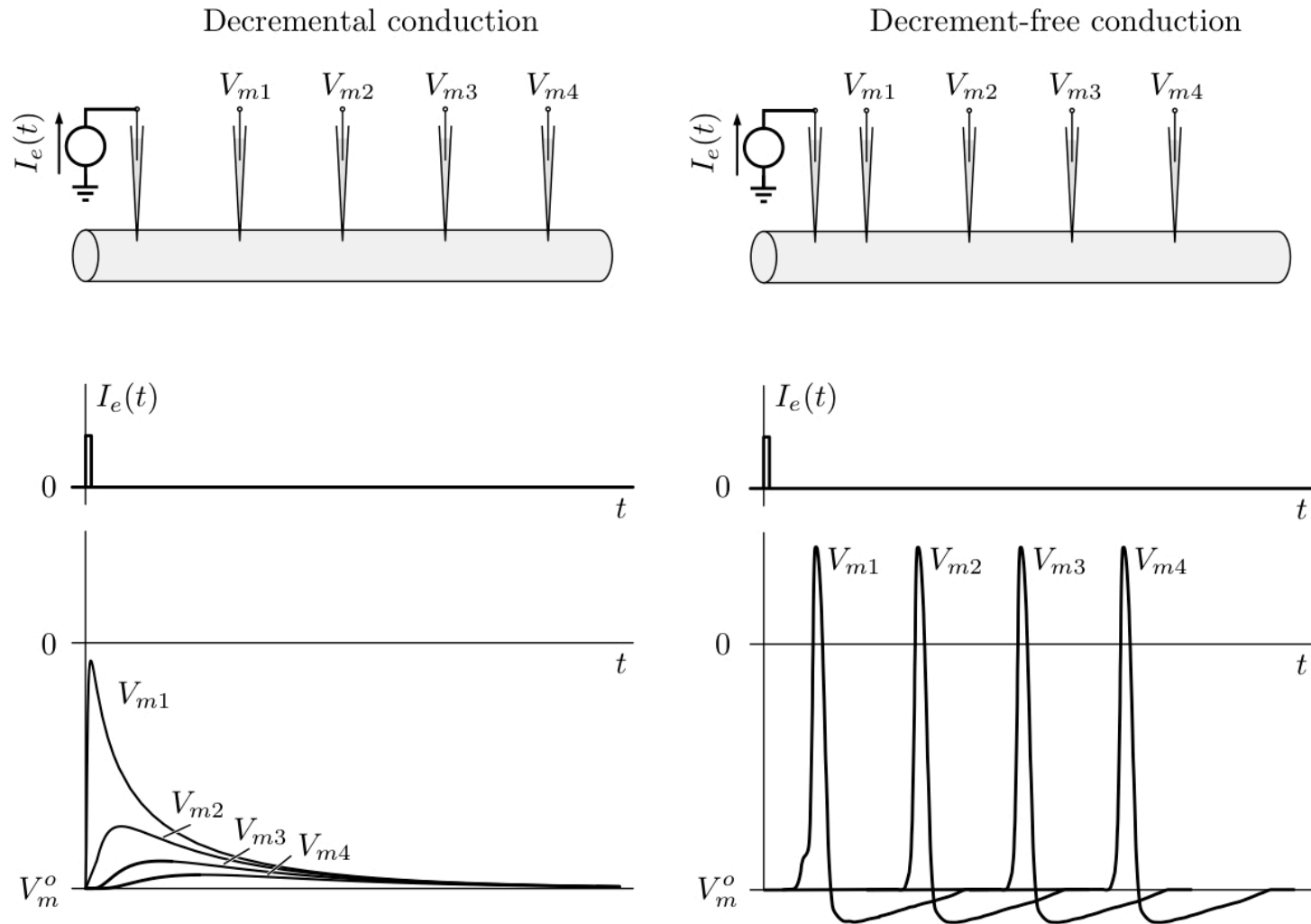


Figure 1.16

Propagated APs

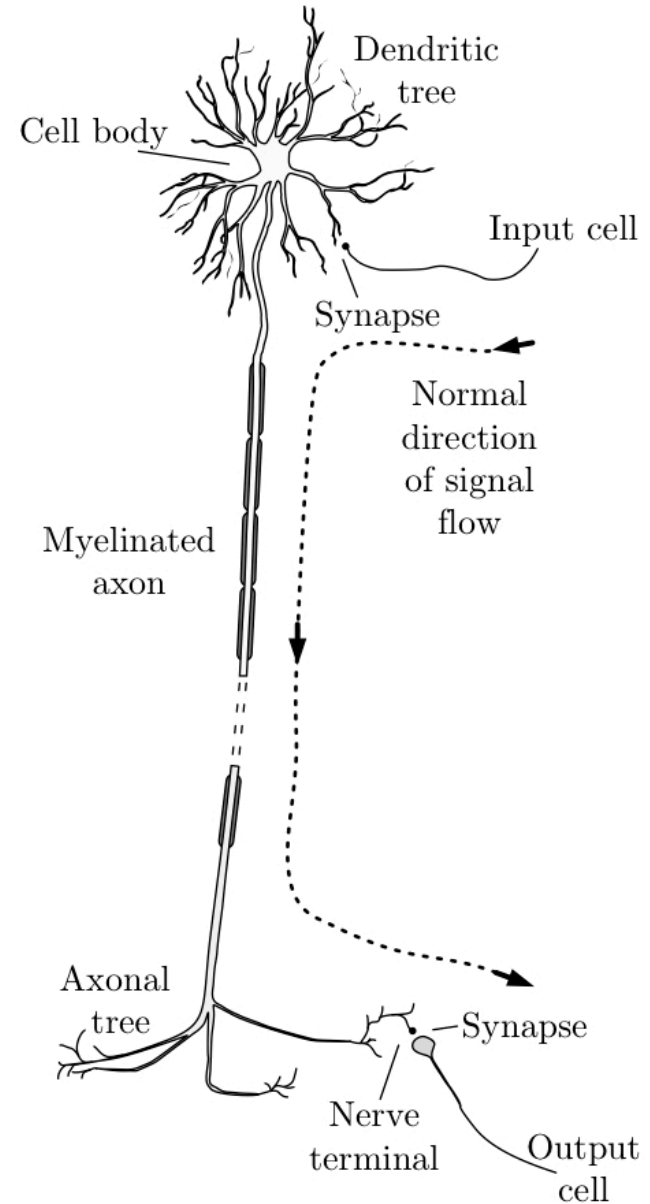
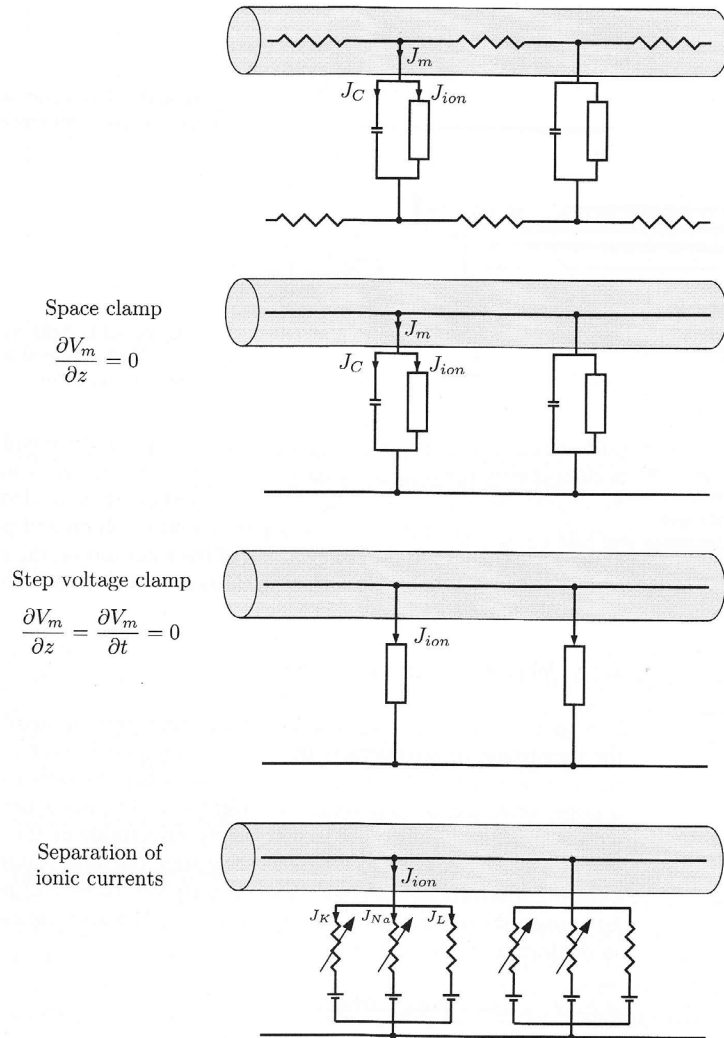


Figure 1.22

Propagated APs

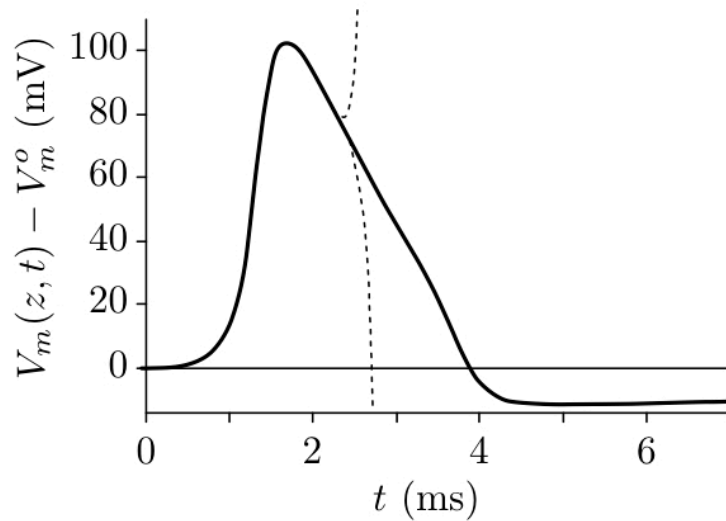


Figure 4.30

→ Solutions only stable for appropriate choice of conduction velocity
(think back to cable model; C_m matters!)

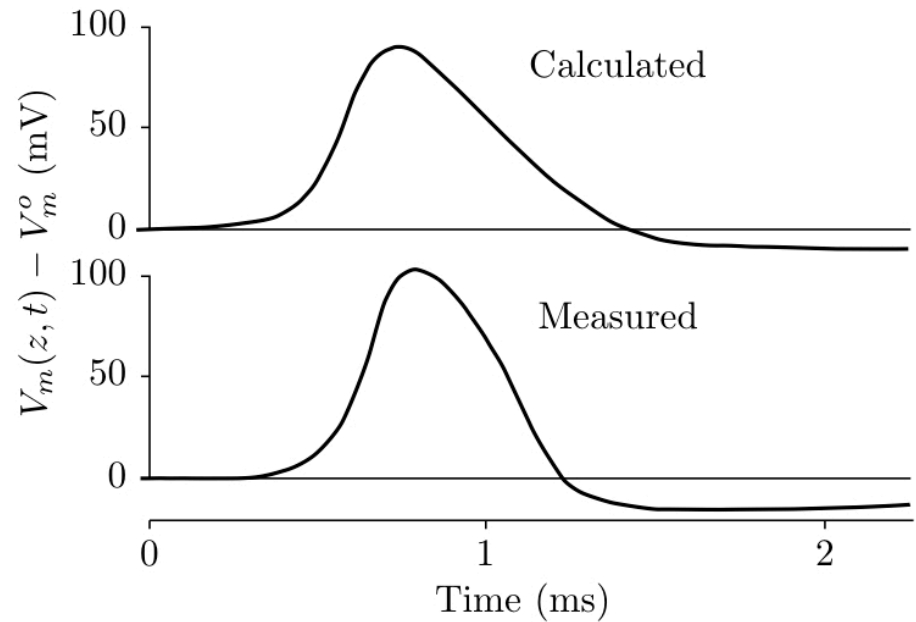


Figure 4.31

Propagated APs

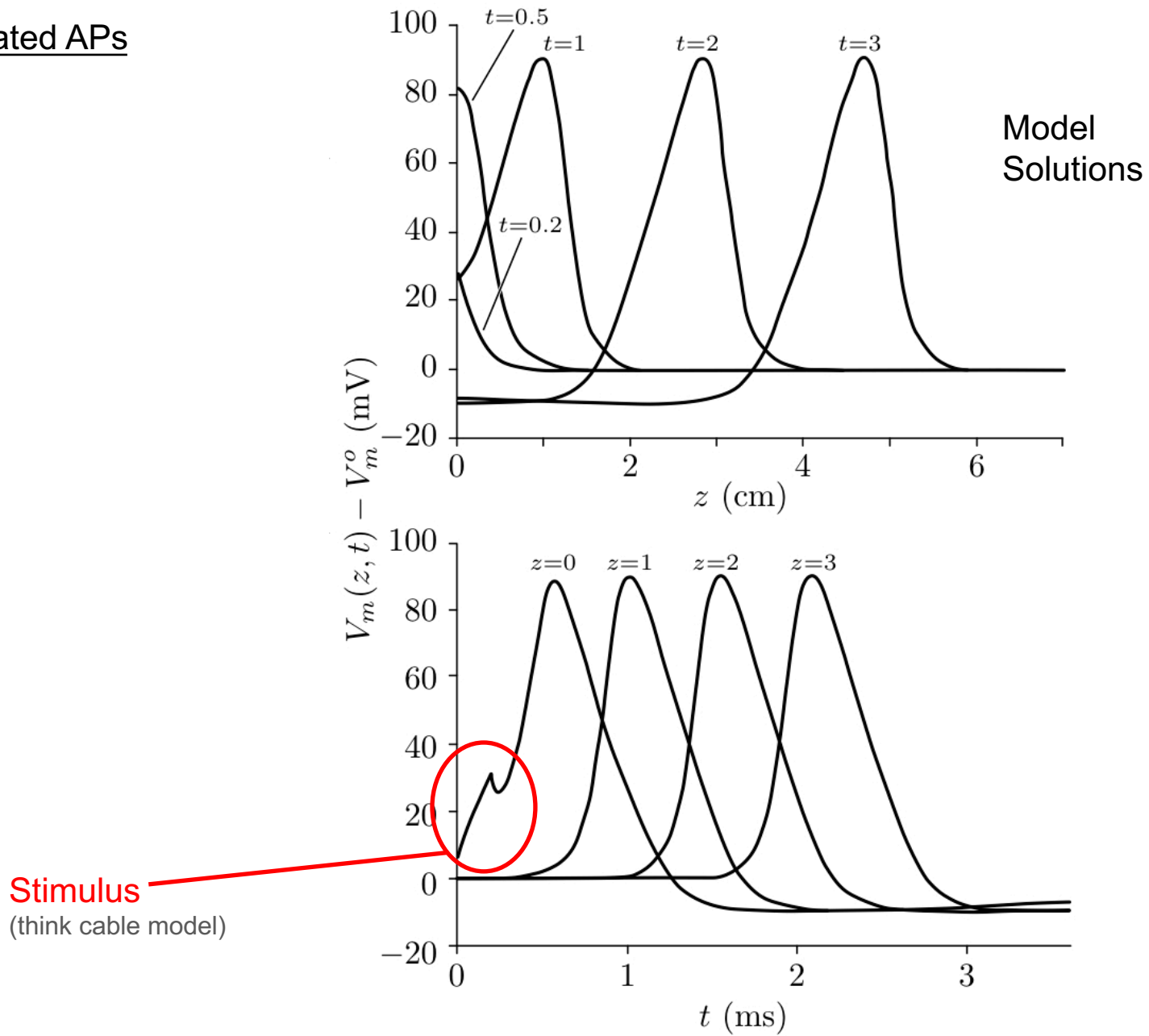
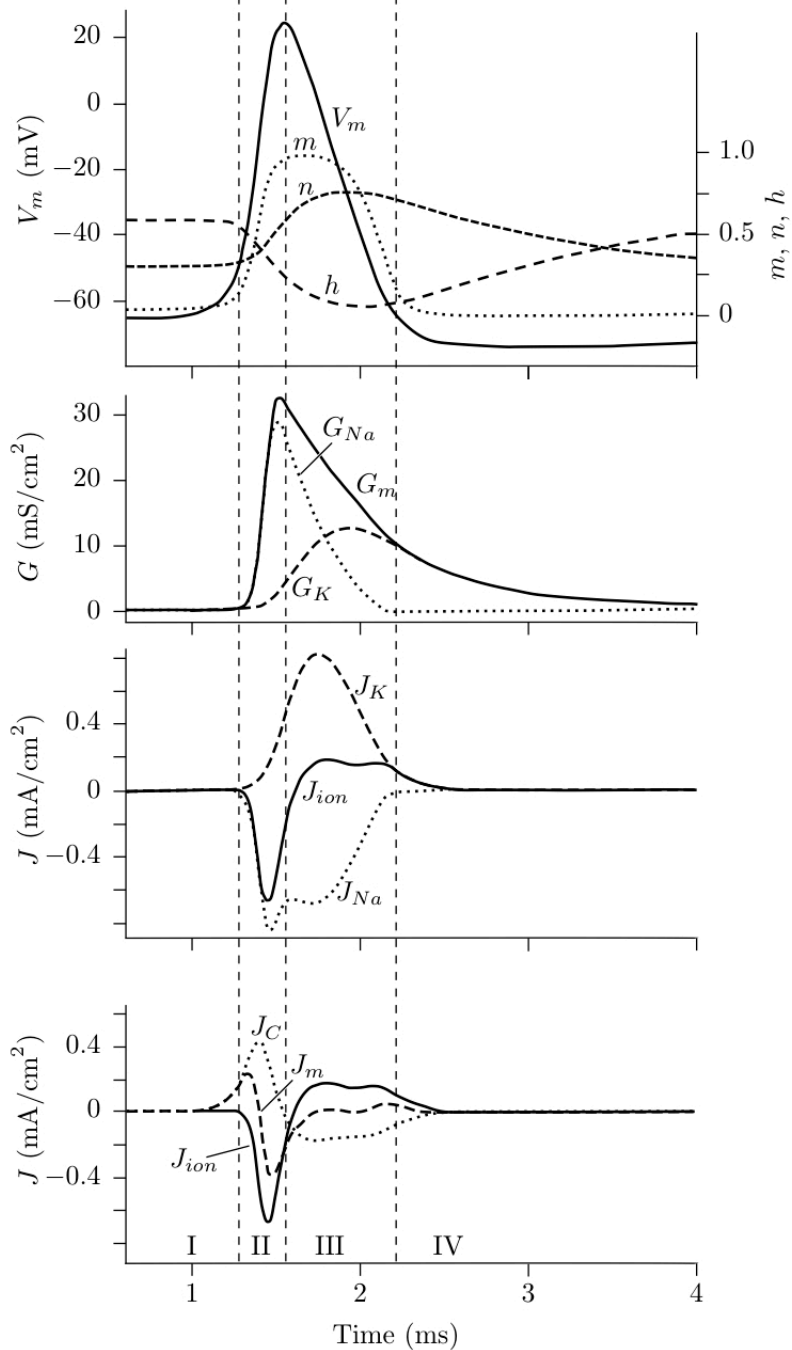


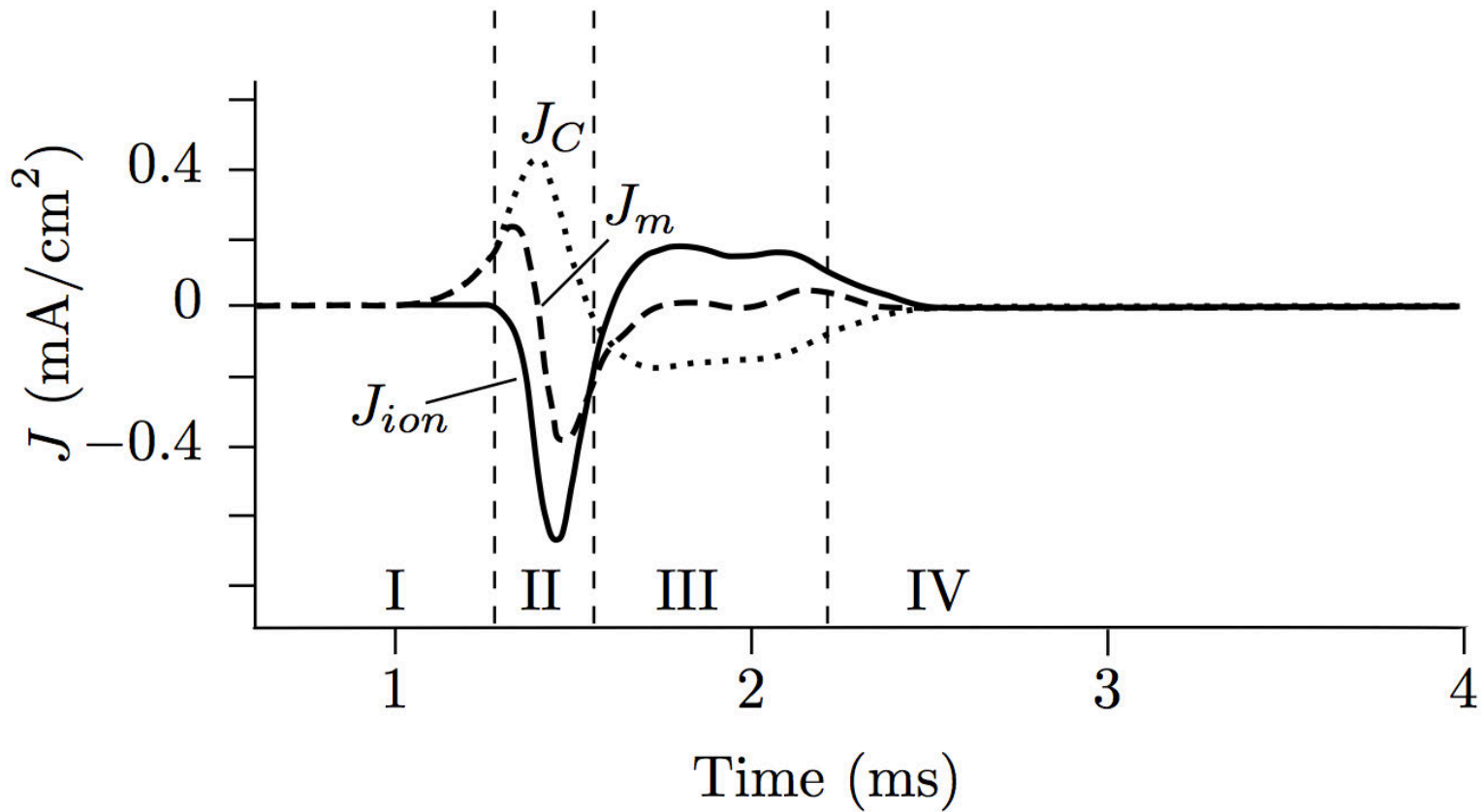
Figure 4.29



Similar picture as before for propagated AP

→ Note lag between V_m and G_m
(stems from capacitive surge)

Figure 4.32



→ Note lag between V_m and G_m
 (stems from capacitive surge)

Myelination

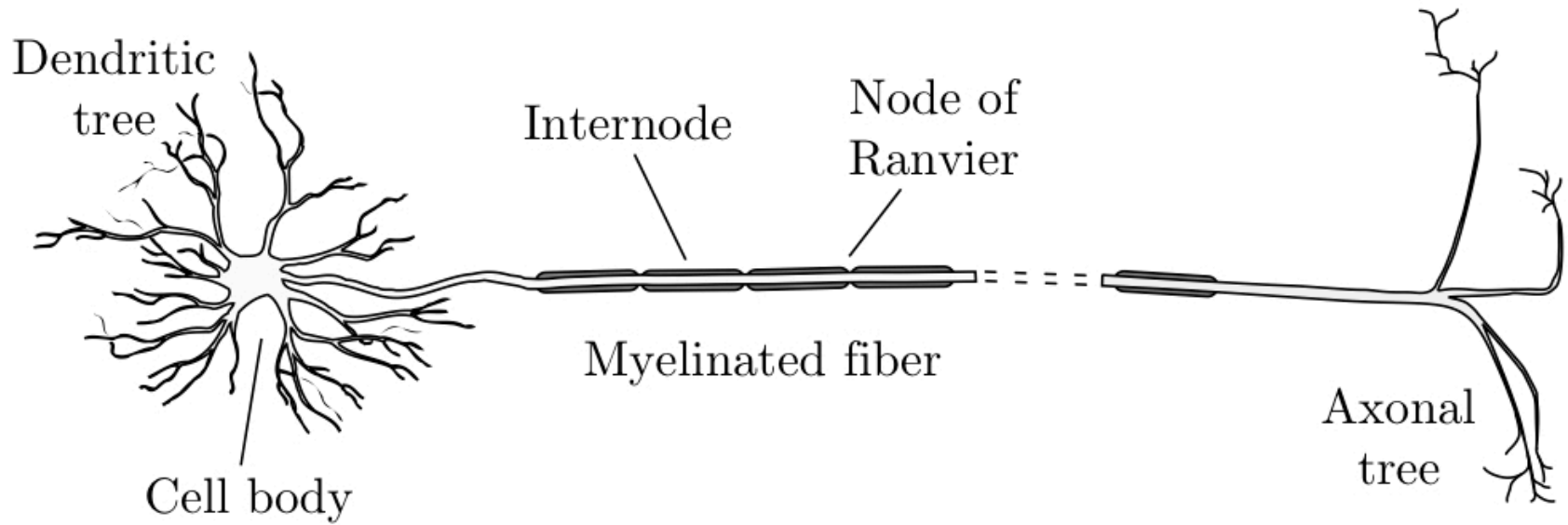


Figure 5.1

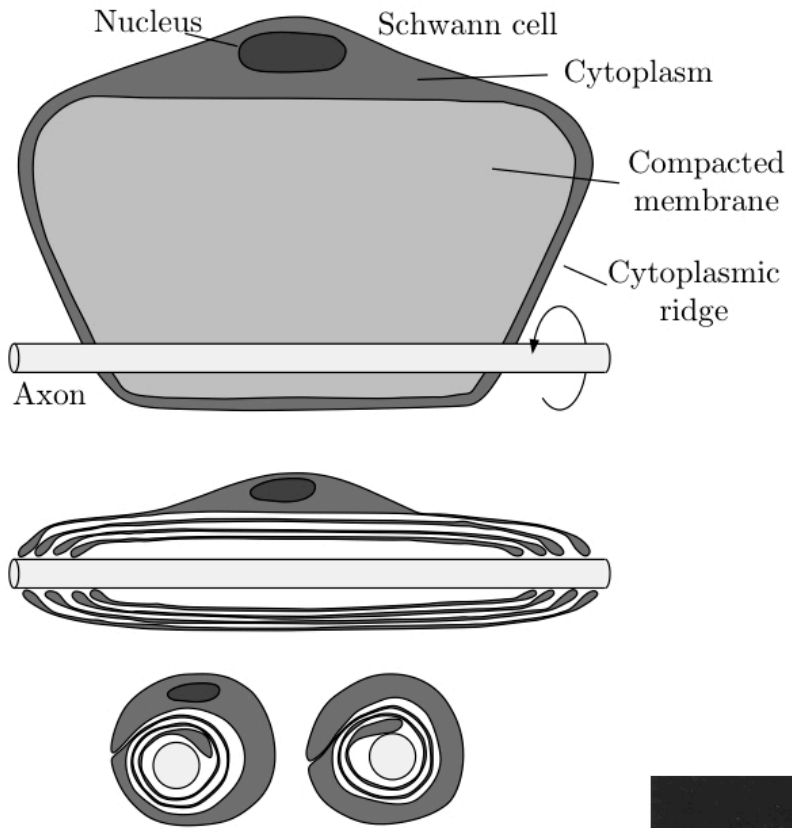


Figure 5.5



Figure 5.6

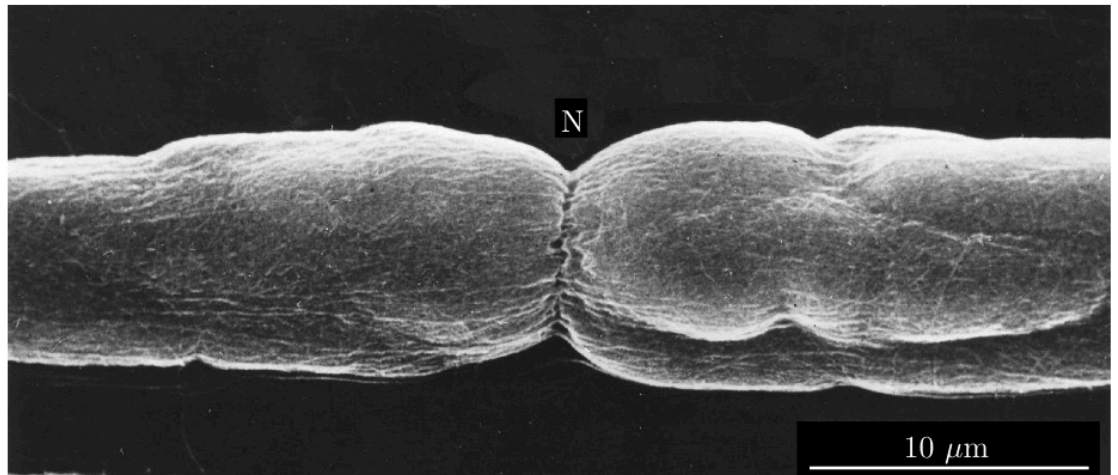


Figure 5.2

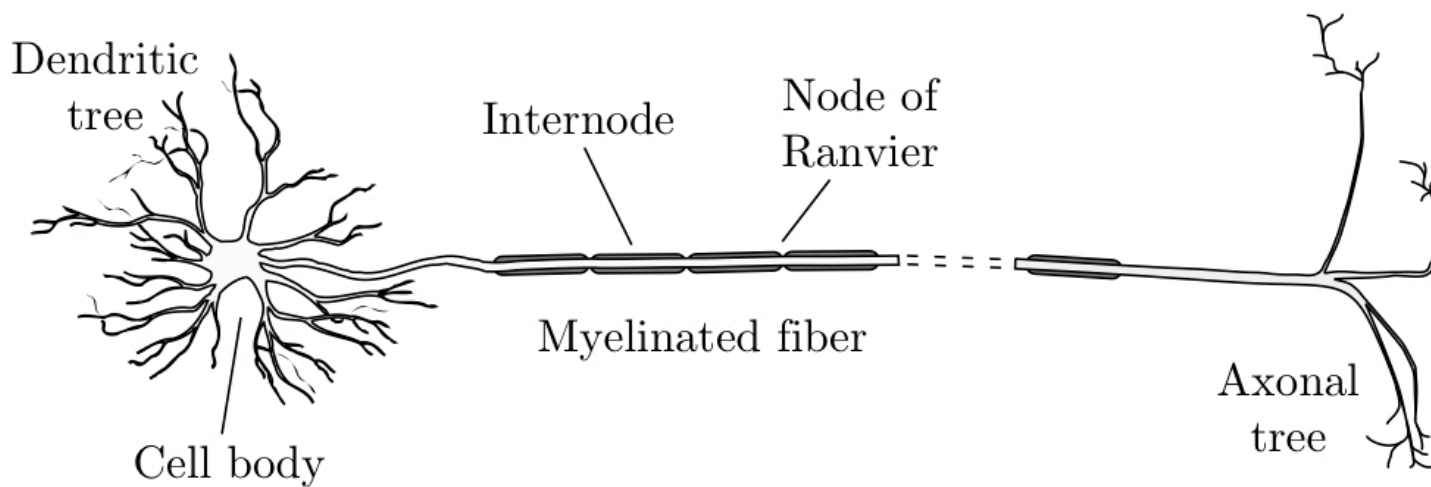
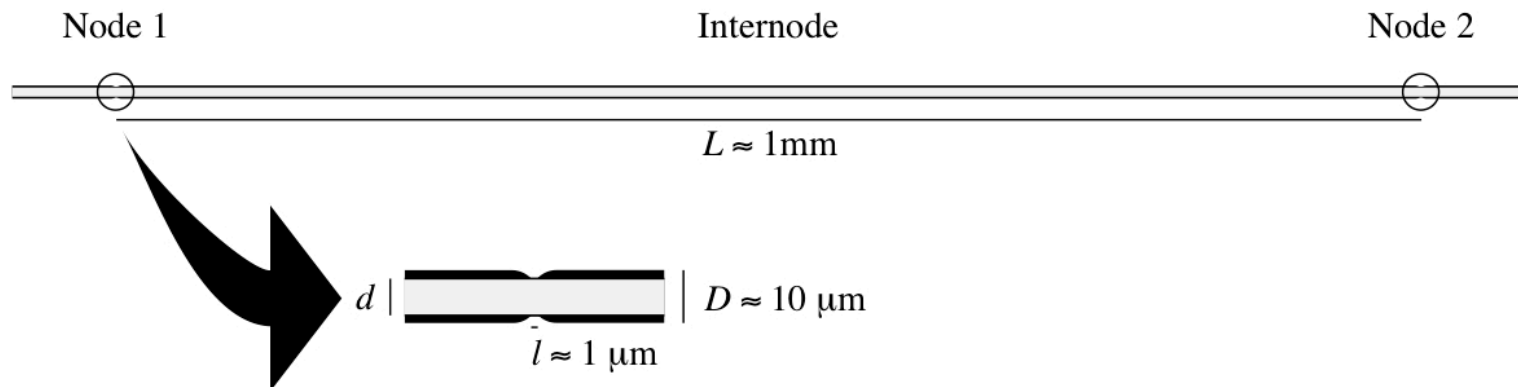


Figure 5.1



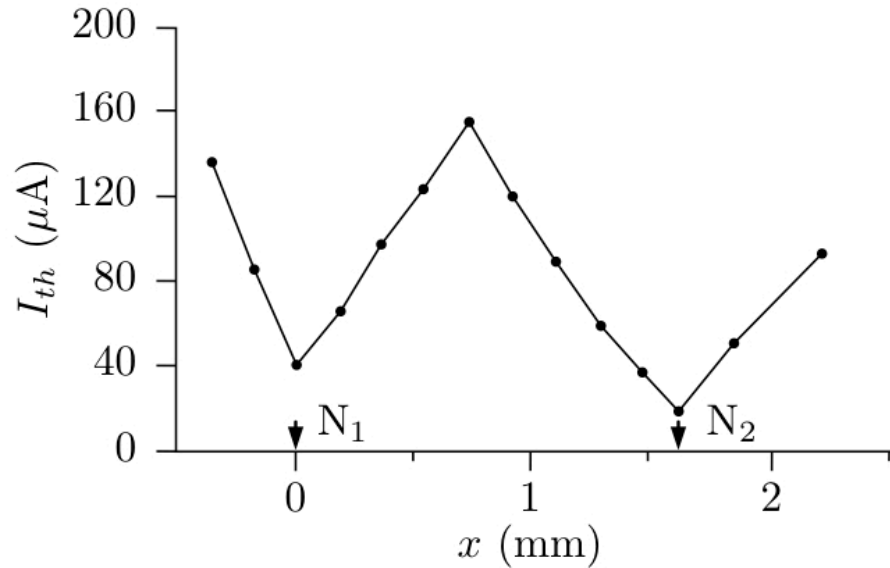
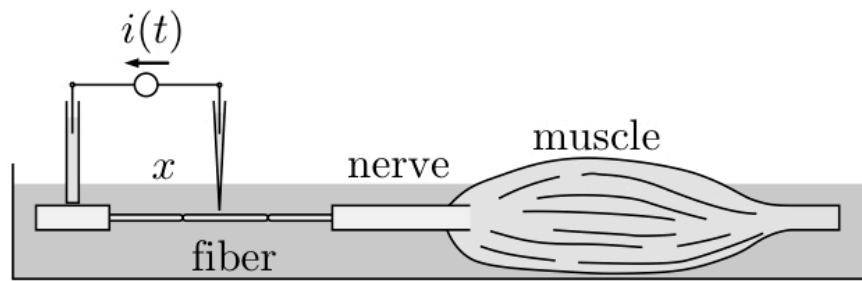


Figure 5.12

→ 'Hopping' behavior of current

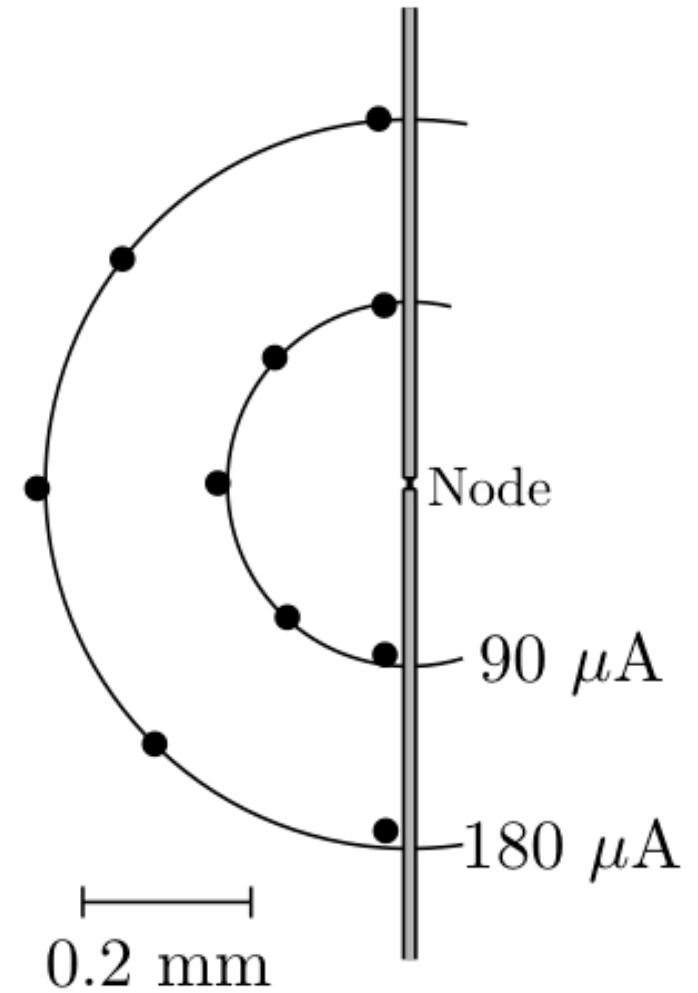


Figure 5.13

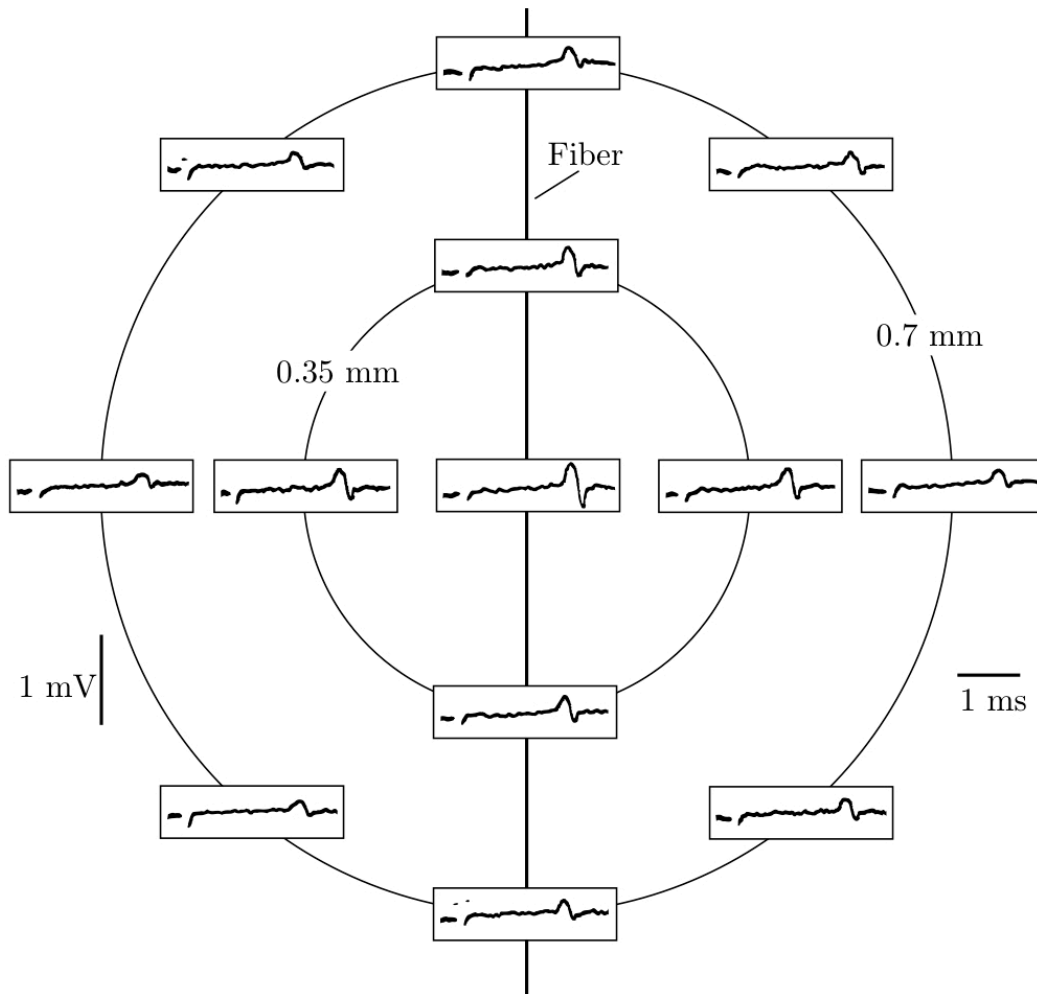


Figure 5.14

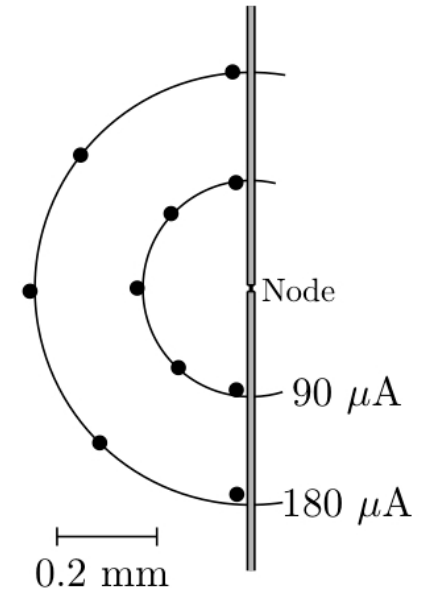


Figure 5.13

- Radial distance from node is important

→ Saltatory conduction

Saltatory Conduction

Plausible biophysical model for saltatory conduction?

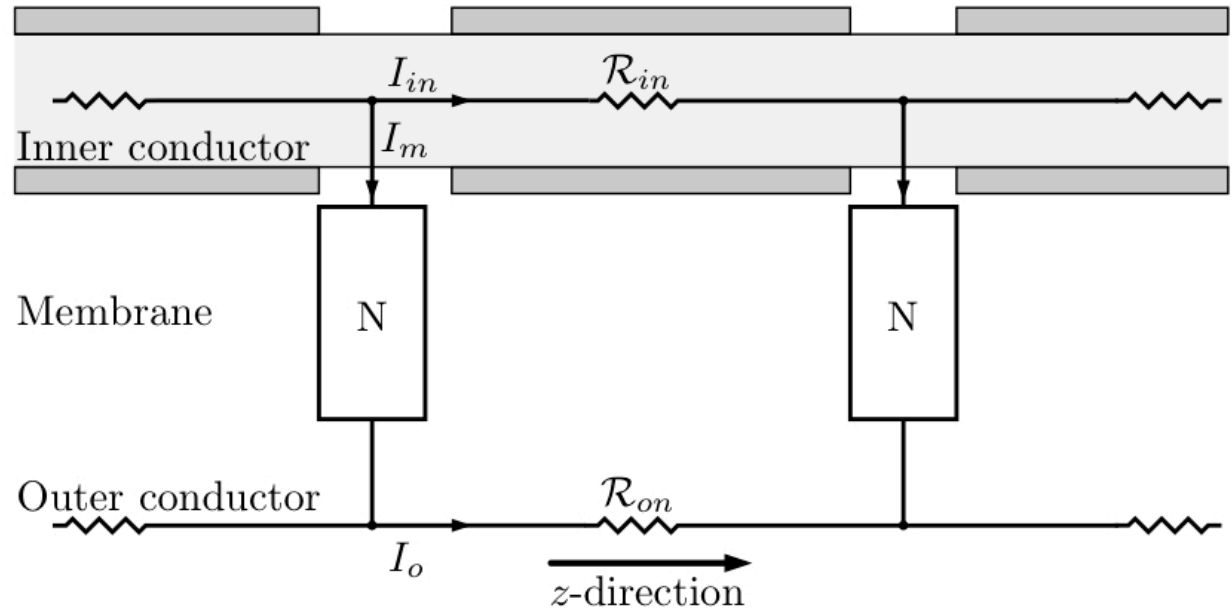


Figure 5.16

- Internodes act as insulators
- APs generated at nodes of Ranvier
- Speeds up propagation without need for larger axon diameter

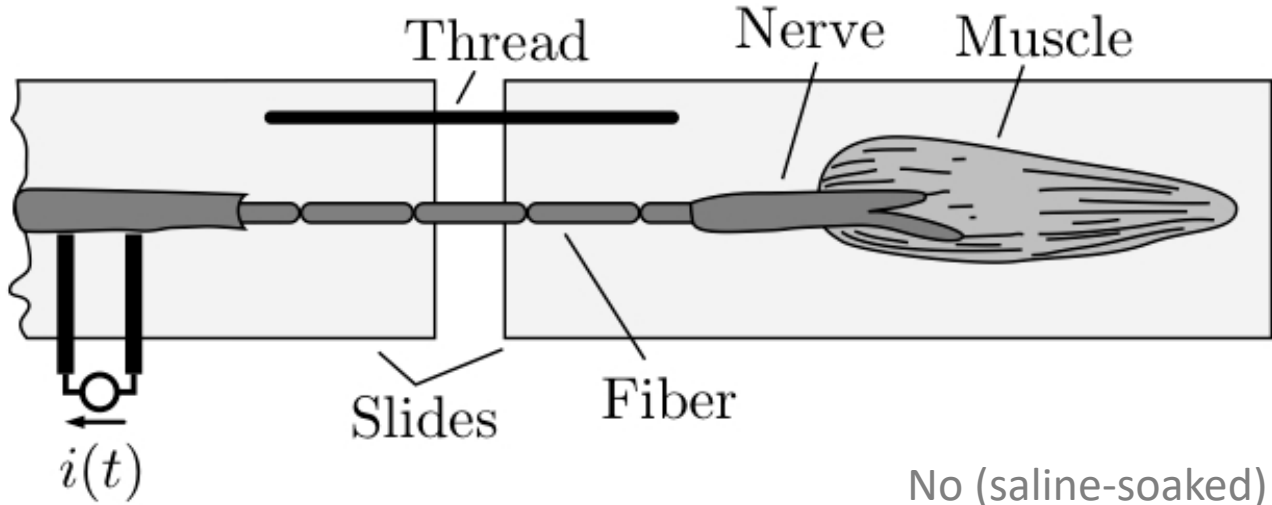


Figure 5.15

→ Extracellular path between nodes is critical

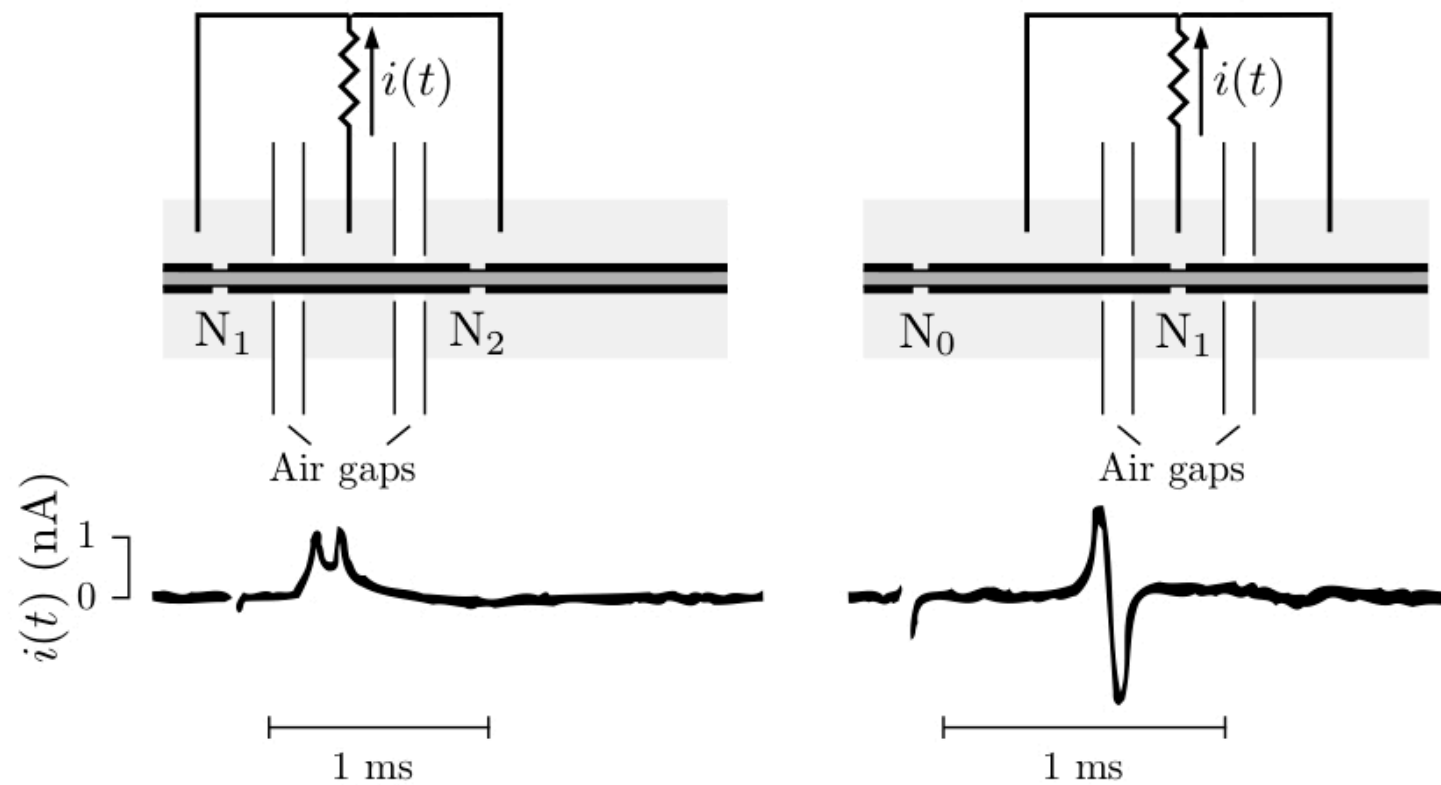


Figure 5.17

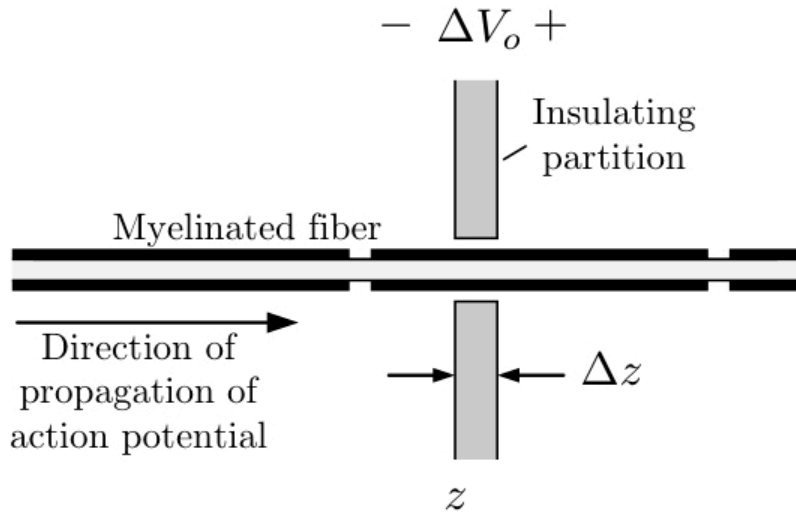


Figure 5.18

→ Current through internodes is non-zero

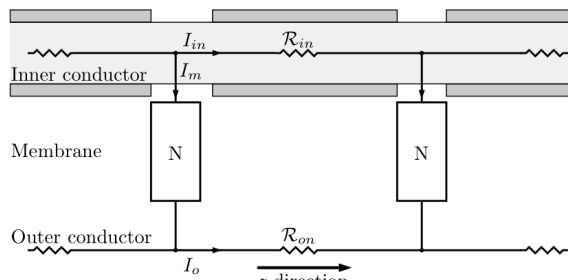


Figure 5.16

This model isn't quite right....

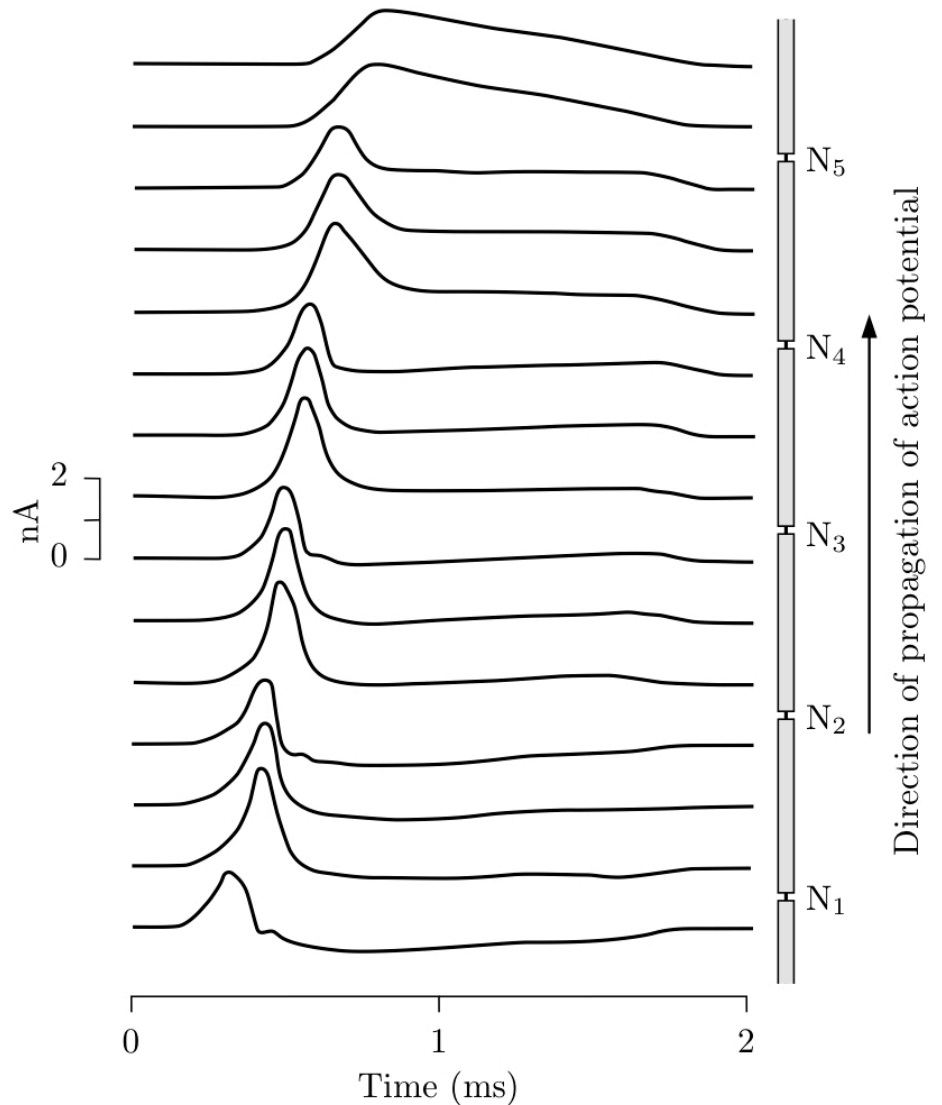


Figure 5.19

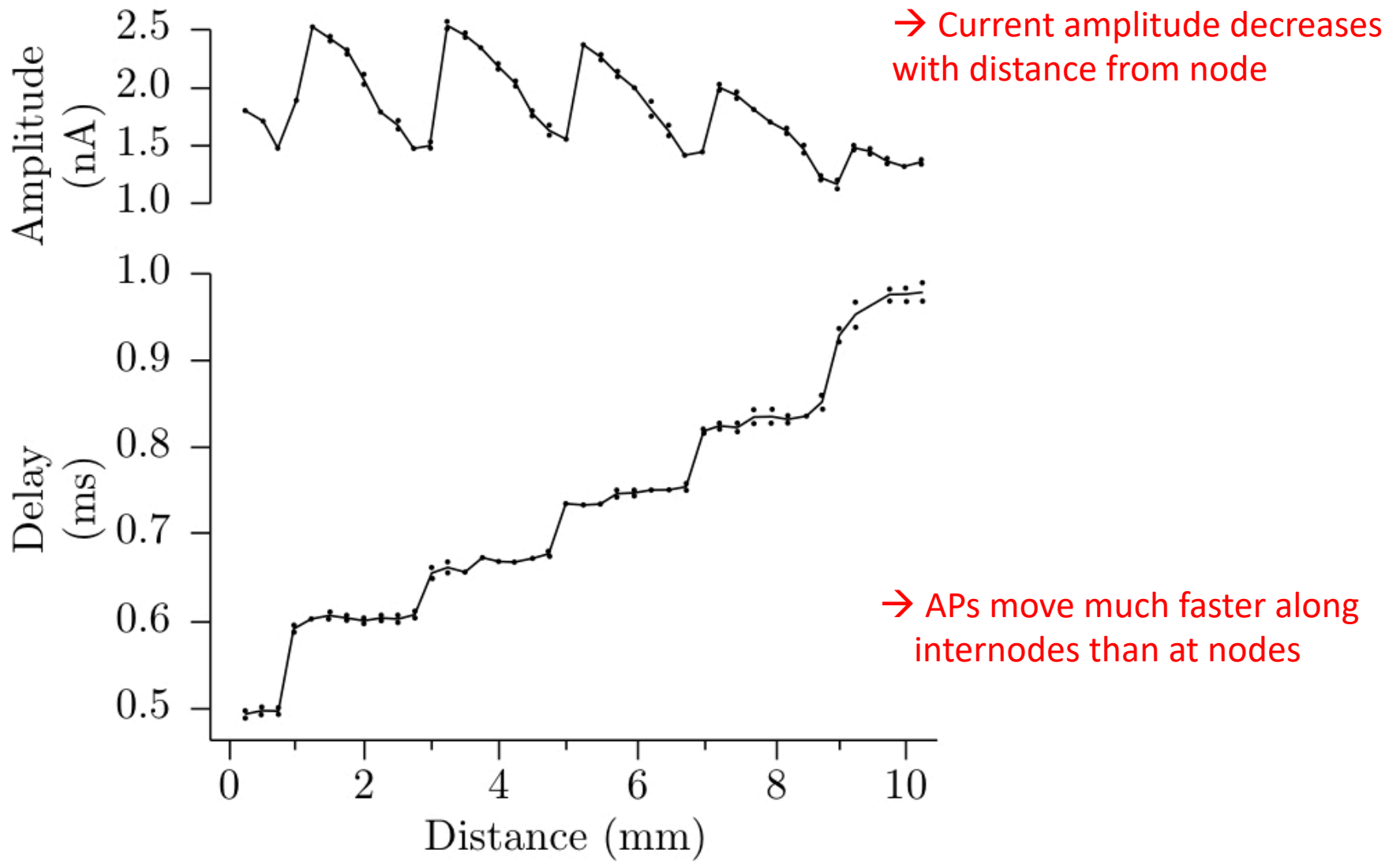


Figure 5.20

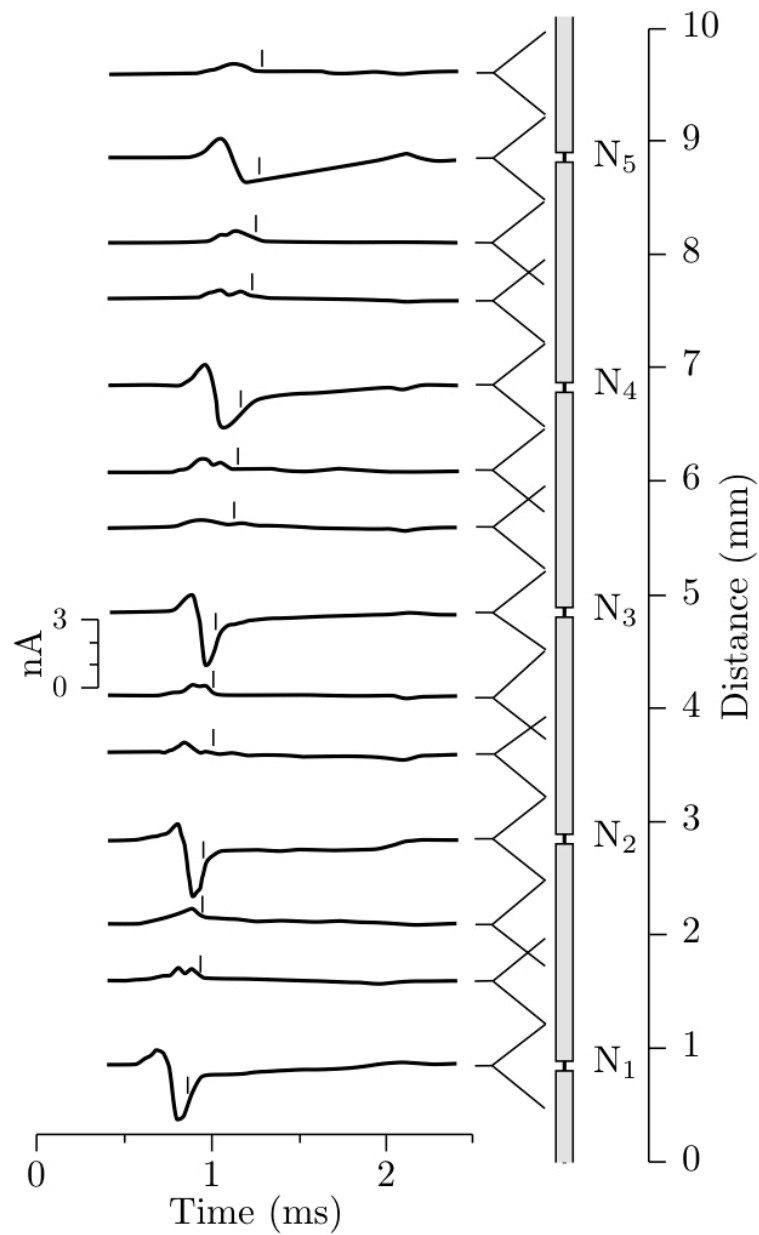
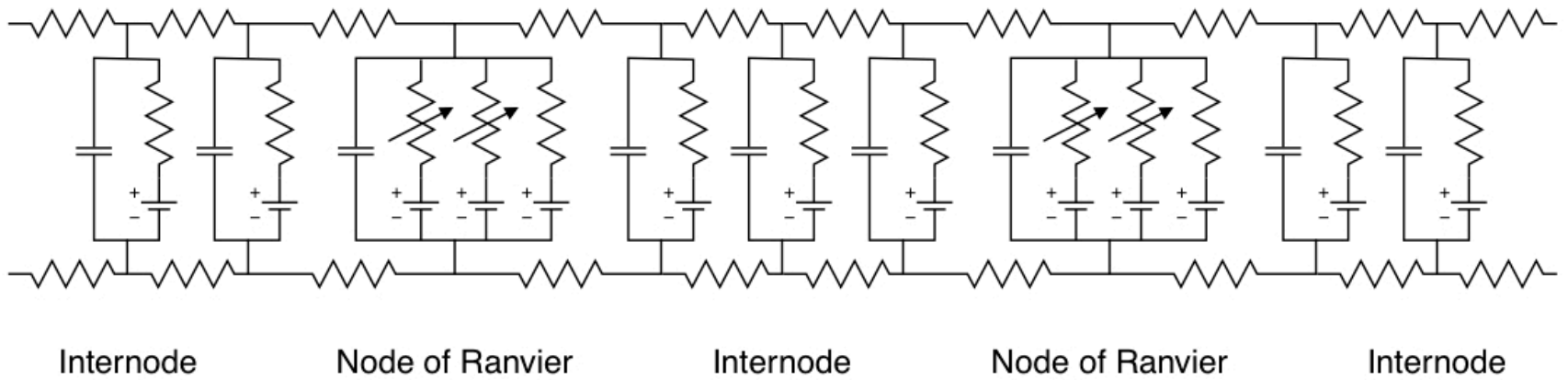


Figure 5.21

→ Internodes behave like cable model
(i.e., leaky submarine cable)

Model of myelinated nerve fiber



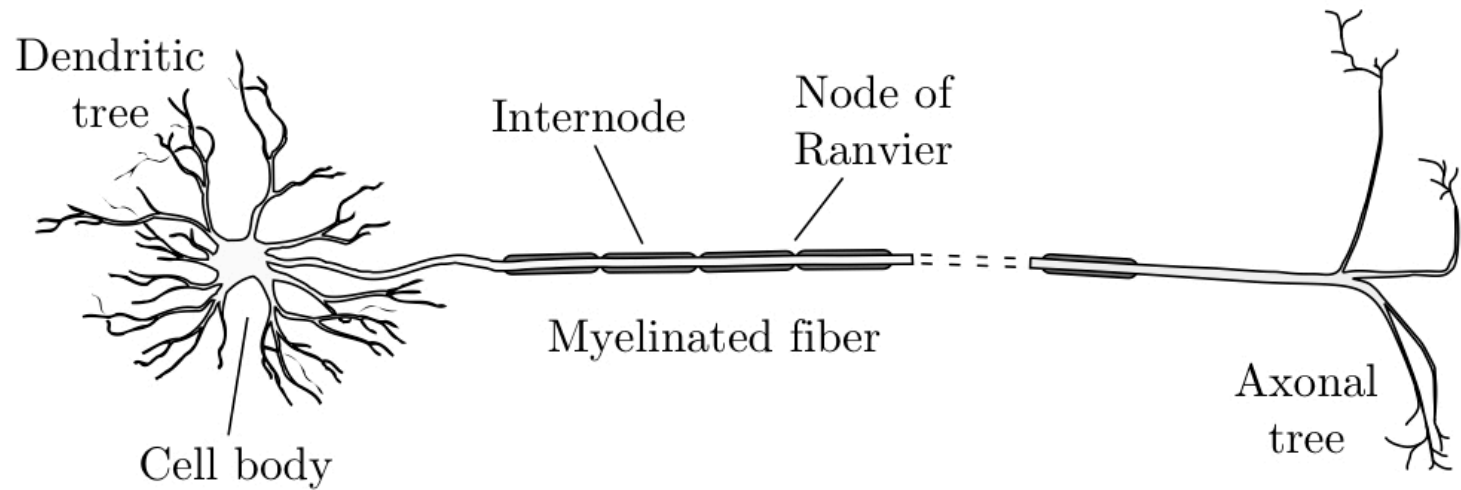
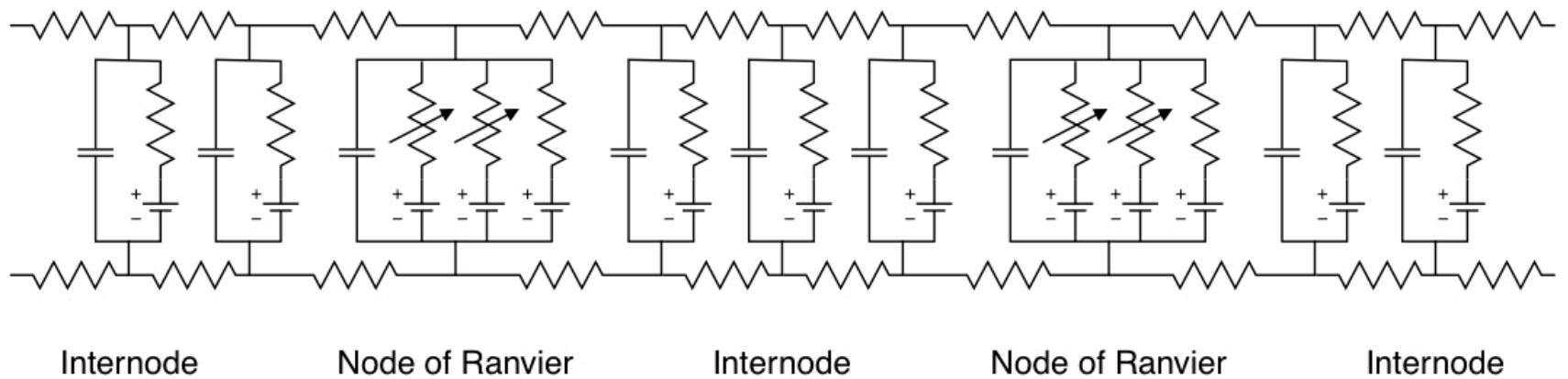


Figure 5.1

Model of myelinated nerve fiber



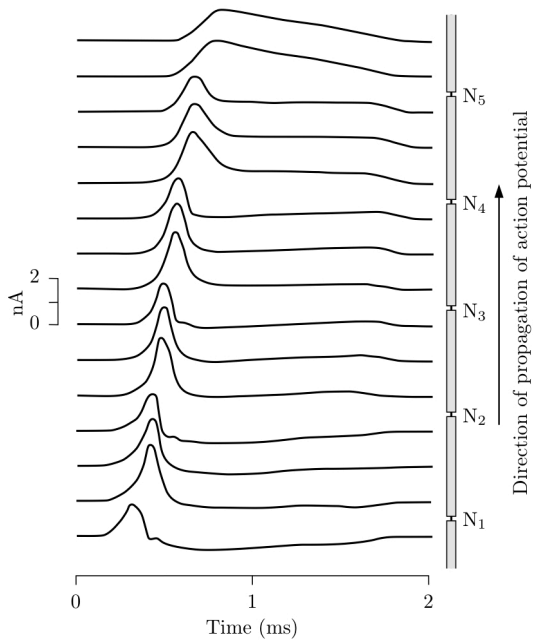


Figure 5.19

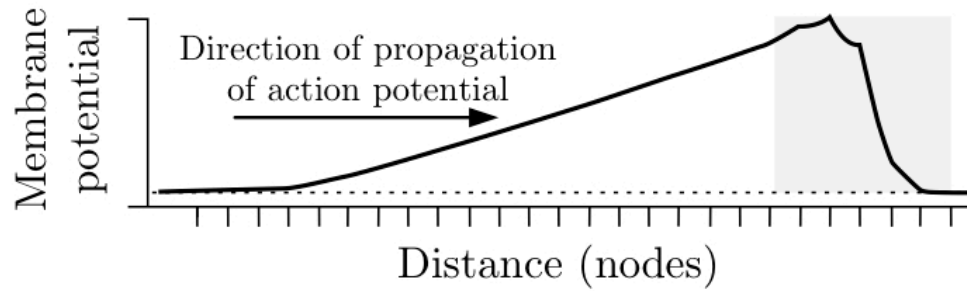


Figure 5.22

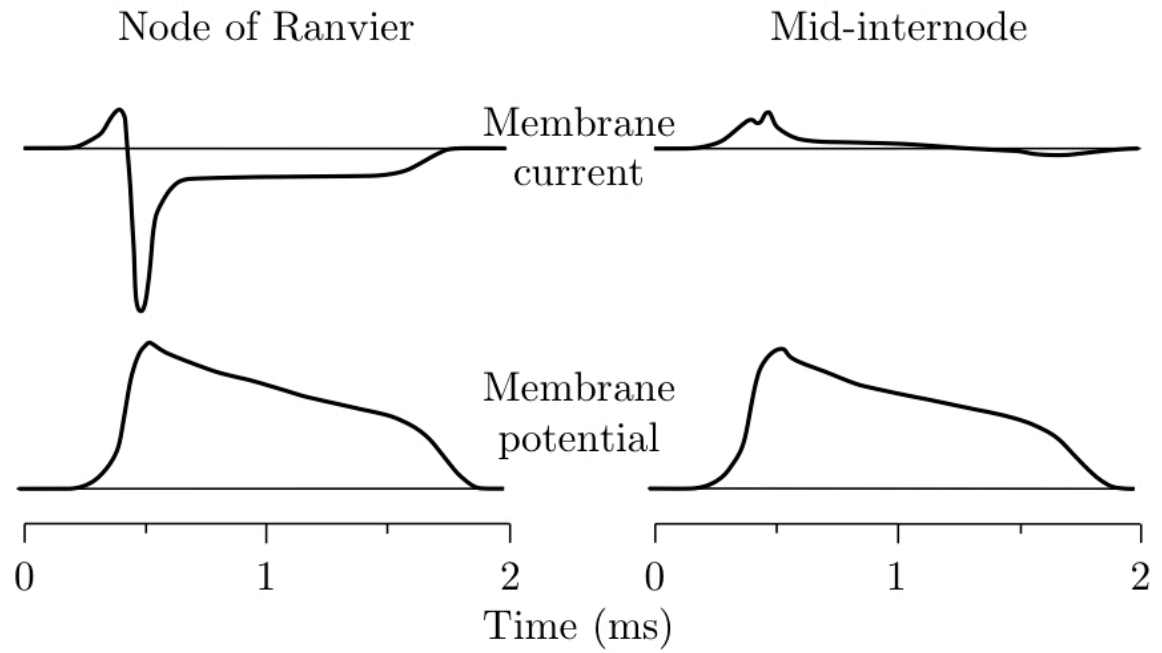


Figure 5.23